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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,048	07/07/2003	Nobuaki Tarumi	60188-550	4739

7590 06/30/2004  
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Washington, DC 20005-3096

EXAMINER
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SARKAR, ASOK K

ART UNIT	PAPER NUMBER
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2829

DATE MAILED: 06/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/613,048	TARUMI ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Asok K. Sarkar	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 07 July 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>7/7/2003</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 102***

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 3 and 5 – 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Chen, US 6,498,091.

Regarding claim 1, Chen teaches a method of manufacturing a semiconductor device comprising:

- a first step of forming an insulating film 16 including a contact hole 18 on a substrate 12 with reference to Fig. 3;
- a second step of forming a conductive underlying layer 30 on the insulating film inclusive of the sidewall surface and the bottom surface of the contact hole;
- a third step of subjecting the underlying layer to sputter-etching so that a part of the underlying layer deposited on the bottom surface of the contact hole is at least partially deposited on the lower part of the sidewall surface of the contact hole with reference to Fig. 3; and
- a fourth step of forming a metal layer 46 on the underlying layer by plating with reference to Fig. 6 in between column 4, line 44 and column 5, line 65.

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Regarding claim 3, Chen teaches the underlying layer is a barrier layer for preventing atoms constituting the metal layer from diffusing into the insulating film (inherent property of the barrier layer), and the method further comprises, between the third step and the fourth step, a fifth step of forming a plating seed layer made of metal on the barrier layer inclusive of the sidewall surface and the bottom surface of the contact hole with reference to Fig. 6 in column 5, lines 1 – 65.

Regarding claim 5, Chen teaches Cu as seed layer and metal layer with reference to Fig. 6 in column 5, lines 48 – 65.

Regarding claims 6 – 8, Chen teaches removing a portion of the barrier layer deposited on the bottom surface of the contact hole, two barrier layers of Ta/TaN and performing the sputter etch process for both barriers with reference to Fig. 7 and descriptions in columns 5 and 6.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.

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3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 2 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen, US 6,498,091 in view of Gopalraja, US 6,451,177.

Regarding these claims Chen teaches a sputter etch and sputter deposition process for the Cu seed layer in column 2, lines 21 – 16 and in column 7, lines 45 – 48 but fails to teach the method further comprising, between the fifth step and the fourth step, a sixth step of subjecting the plating seed layer to sputter-etching so that a part of the plating seed layer deposited on the bottom surface of the contact hole is at least partially deposited on the lower part of the sidewall surface of the contact hole.

Gopalraja teaches a process of subjecting the plating seed layer to sputter-etching so that a part of the plating seed layer deposited on the bottom surface of the contact hole is at least partially deposited on the lower part of the sidewall surface of the contact hole with reference to Figs 18 and 19 in between column 18, line 35 and column

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19, line 62 for the benefit of providing a low-resistance contact between underlying and overlying copper layers in column 4, lines 49 – 52.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Chen and apply the process of subjecting the plating seed layer to sputter-etching so that a part of the plating seed layer deposited on the bottom surface of the contact hole is at least partially deposited on the lower part of the sidewall surface of the contact hole for the benefit of providing a low-resistance contact between underlying and overlying copper layers as taught by Gopalraja in column 4, lines 49 – 52.

### ***Conclusion***

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Simon, US 5,933,753 teaches a method for filling a via in which the coating at the bottom of the layer is sputter etched for depositing on the sidewall.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 571 272 1970. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kammie Cuneo can be reached on 571 272 1957. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*Asok K. Sarkar*

Asok K. Sarkar  
June 16, 2004

Patent Examiner